MATHEMATICS

Chapter 4: Practical Geometry

Practical Geometry

1. A quadrilateral is a four-sided polygon.

2. A quadrilateral has four sides, four angles and two diagonals, i.e., 10 elements. A quadrilateral can be constructed uniquely if at least five of its elements are given.

3. A quadrilateral can be constructed uniquely, if we know any one of the following:
    i. Four sides and one diagonal
    ii. Four sides and one angle
    iii. Two diagonals and three sides
    iv. Two adjacent sides and three angles
    v. Three sides and two included angles

4. For the construction of different type of quadrilaterals like parallelogram, rhombus, trapezium etc. we use their properties.

Construction of a Quadrilateral

It is very easy to construct a quadrilateral when its five measurements are determined that is

- The length of the four sides and the length of its diagonal is known
- The length of the three sides and the length of the two diagonals are known
- If the three angles and two adjacent sides are given
- If the three sides and two angles are given

4 Sides and 1 Diagonal

Construction of a Quadrilateral when different measures of sides and angles are given

A unique quadrilateral can be constructed when the following measurements are given:

- Four sides and one diagonal.
- Two diagonals and three sides.
- Two adjacent sides and three angles.
- Three sides and two included angles.
- When other special properties are known.

SSS Construction

- To construct a $\triangle ABC$, the length of whose sides are, AB = x cm, BC = y cm, and AC = z cm, we will do it in the following manner:
- Construct a line segment AB, whose length is x cm.
- With A as the center, draw an arc of radius z cm.
- With B as the center, draw an arc of radius y cm on the same side. The point where the arcs intersect is the required point C.
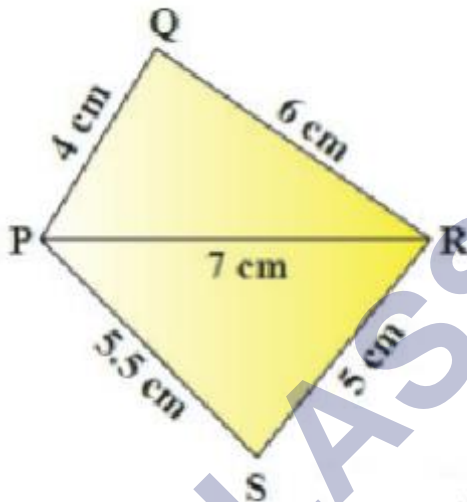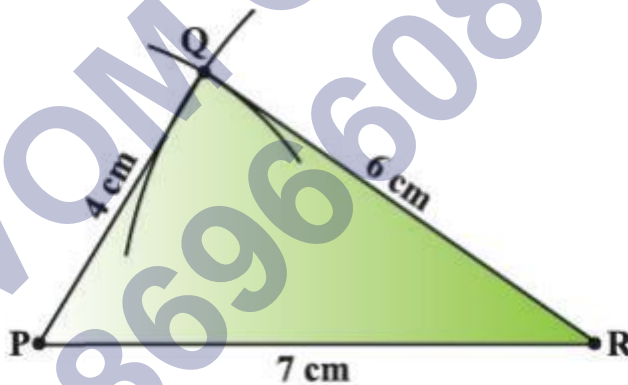- Join AC and BC.

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△ ABC is the required triangle.

Construction of a Quadrilateral when four sides and one diagonal are given

Suppose we have to construct a quadrilateral PQRS, where PQ = 4 cm, QR = 6 cm, RS = 5 cm, PS = 5.5 cm and PR = 7 cm.

**Step 1:** Draw a rough sketch to visualize the quadrilateral.

Step 2: Draw △ PQR as it can be constructed using SSS construction condition.

Step 3: Now we have to locate S, which is at a distance of 5.5 cm from P and 5 cm from R. Also it will be on the opposite side of Q.

With P as center draw an arc of radius 5.5 cm. With R as center draw an arc of radius 5 cm.

S is the point of intersection of the two arcs.

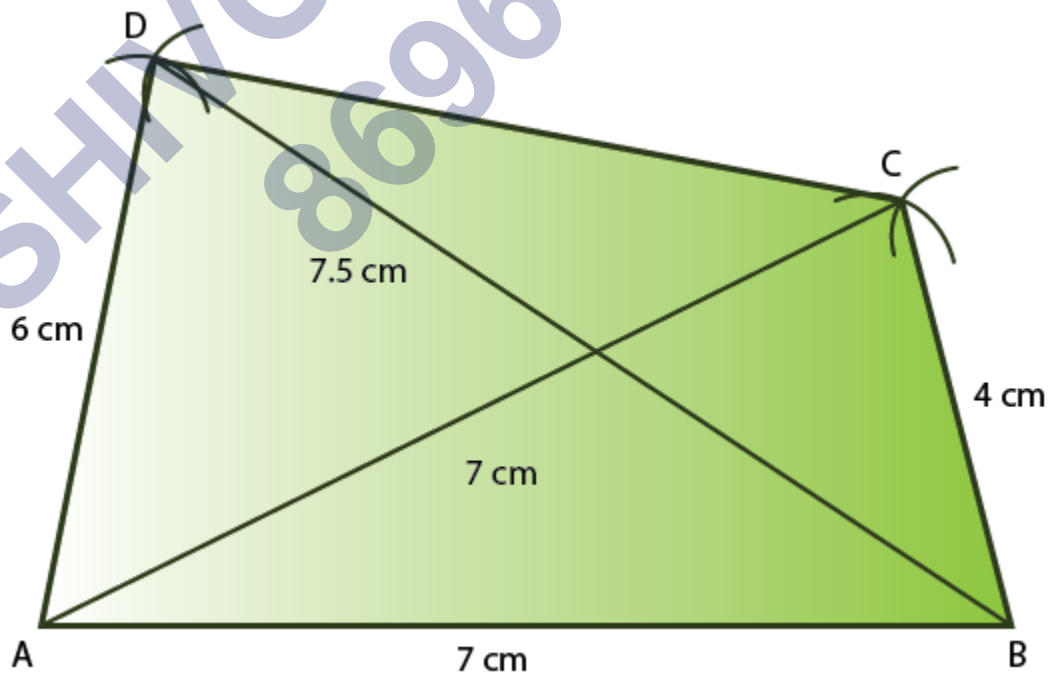**Step 4:** Join PS and RS. PQRS is the required quadrilateral.

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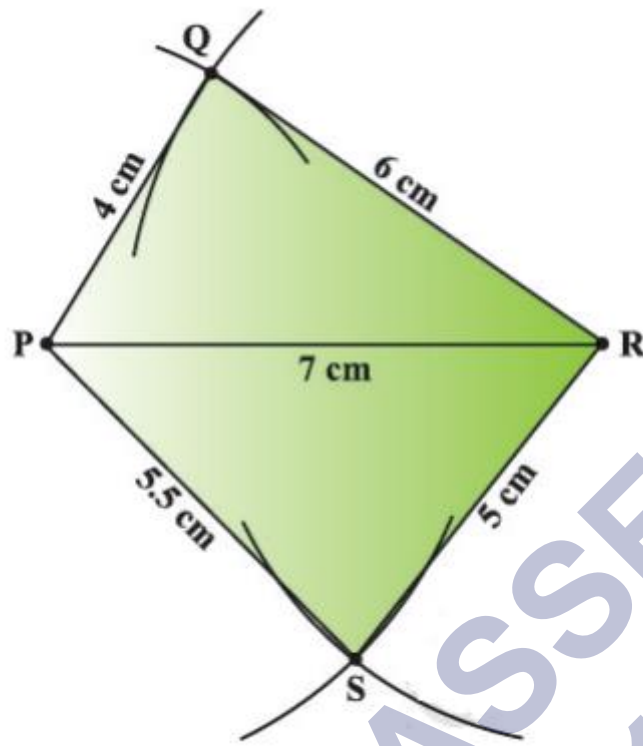
3 Sides and 2 Diagonals

Construction of a Quadrilateral when two diagonals and three sides are given

Construct a quadrilateral ABCD given, AB = 7 cm, AD = 6 cm, AC = 7 cm, BD = 7.5 cm and BC = 4 cm.

[Make a rough figure for your reference]

Steps of construction of the quadrilateral:

(3)

Step 1: △ABC can be drawn by SSS construction condition since all its sides are known.

Step 2: With A as center and radius 6 cm (AD), draw an arc.

Step 3: With B as center and radius 7.5 cm (BD) draw another arc to cut the previous arc at D

Step 4: Join AD, BD, and CD.

ABCD is the required quadrilateral

2 Adjacent Sides and 3 Angles

Construction of a Quadrilateral when two adjacent sides and three angles are given

Construct a quadrilateral ALPN, where AL = 6.5 cm, LP = 4 cm, ∠NAL = 110°, ∠ALP = 75° and ∠LPN = 90°.

[Draw a rough Sketch for your reference]:

Steps of construction of the quadrilateral:

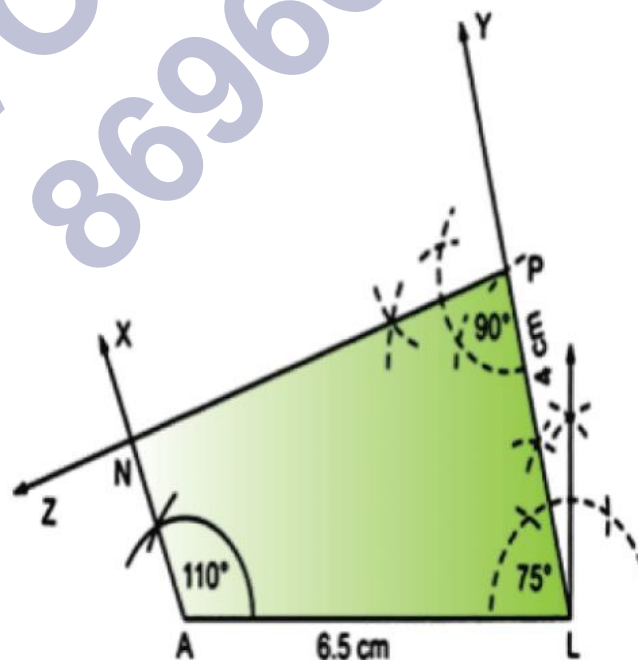Step 1: Draw the line segment AL of length 6.5 cm.

Step 2: Make ∠ALY = 75° at L.

Step 3: Make ∠LAX = 110° at A.

Step 4: With L as center and radius equal to 4 cm, cut an arc on the ray LY at P.

Step 5: Make ∠LPZ = 90° at P.

Step 6: Name the point of intersection of rays PZ and AX as N.
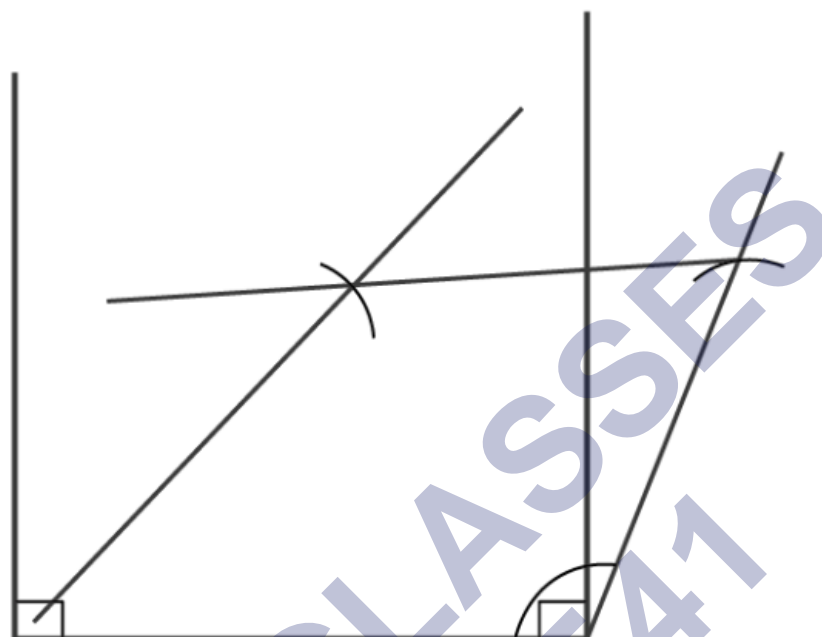
ALPN is the required quadrilateral.

3 Sides and 2 Included Angles

Construction of a Quadrilateral when three Sides and two included angles are given

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Construct a quadrilateral ABCD, Where AB = 4.5 cm; BC = 3.5 cm, CD = 5 cm ∠ABC = 45°, ∠BCD = 150°

[Make a rough figure for your reference]

Steps of construction of the quadrilateral:

Step 1: Draw a line segment BC of length 3.5 cm.

Step 2: Make ∠LBC = 45°.

Step 3: Make ∠BCM = 150°.

Step 4: With B as center and radius equal to 4.5 cm, cut an arc on the ray LB at A.

Step 5: With C as the center and radius equal to 5 cm, cut an arc on the ray CM at D.

Step 6: Join AD.

ABCD is the required quadrilateral.

4 Sides and One Diagonal are Given

Let us say you are required to construct a quadrilateral PQRS where the measurements are:
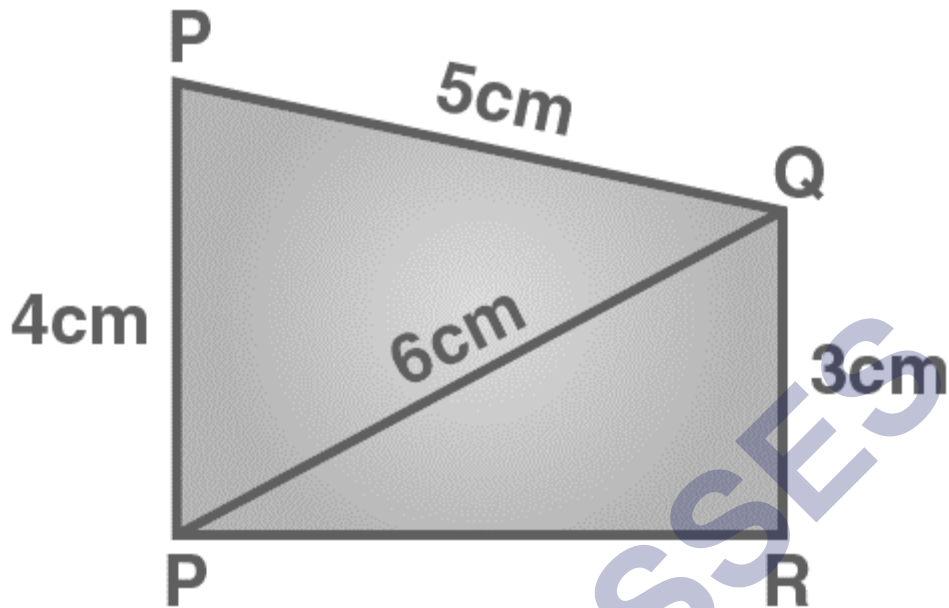
PQ = 5 cm

QR = 3 cm

RS = 5 cm

PS = 4 cm

Diagonal SQ = 6 cm

For the construction of quadrilaterals with some of the measurements given, we first draw

(5)

a rough figure of the quadrilateral with the given dimensions, as shown below.


Now starting with the construction, the steps are:

- Draw a line segment of length 5 cm and mark the ends as S and R.

- Set your compass to the radius of 3 cm and make an arc from the point R above the line segment.
- Set the compass to the radius of 6 cm and make an arc from the point S on the previous arc.
- Mark the point as Q where the two arc cross each other. Join the points S and Q as well as R and Q.

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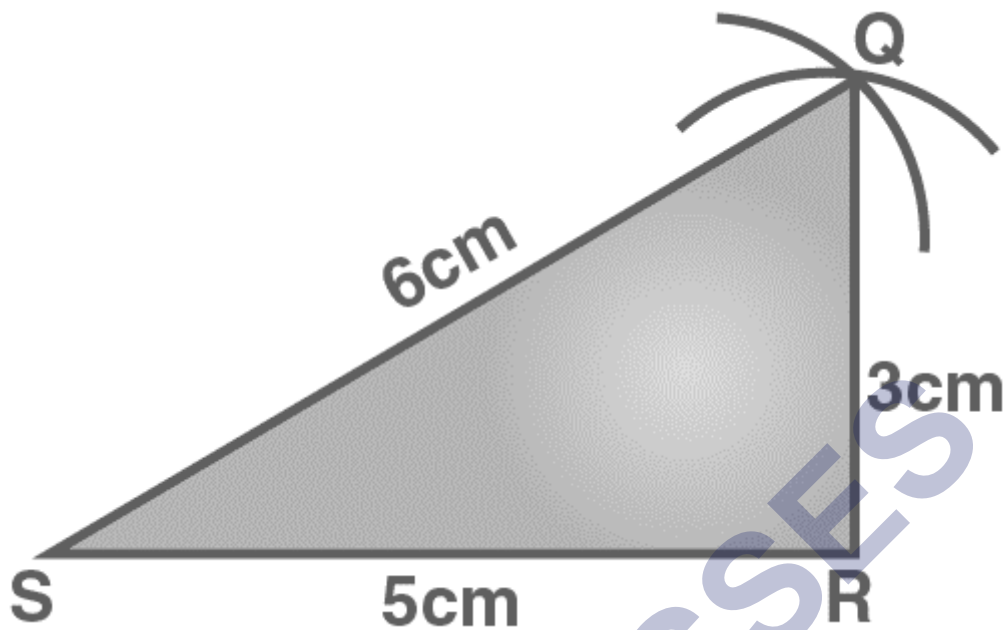
- Set the compass to the radius of 5 cm and make an arc from the point Q.
- Set the compass to the radius of 4 cm and make an arc from the point S on the previous arc.
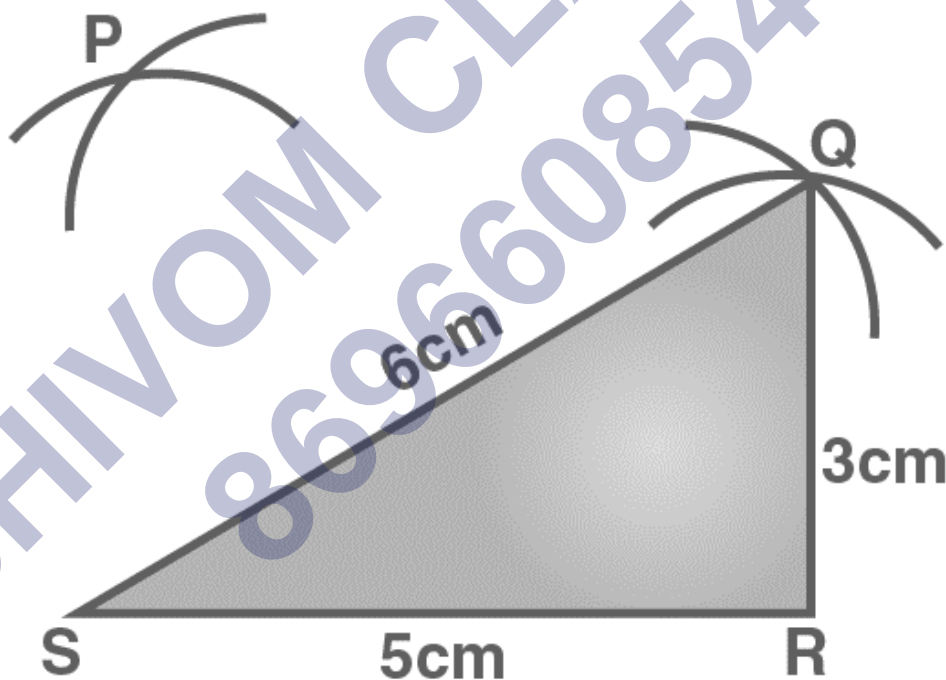
- Mark the point as P where the two arc cross each other.
- Join the points P and Q as well as P and S.

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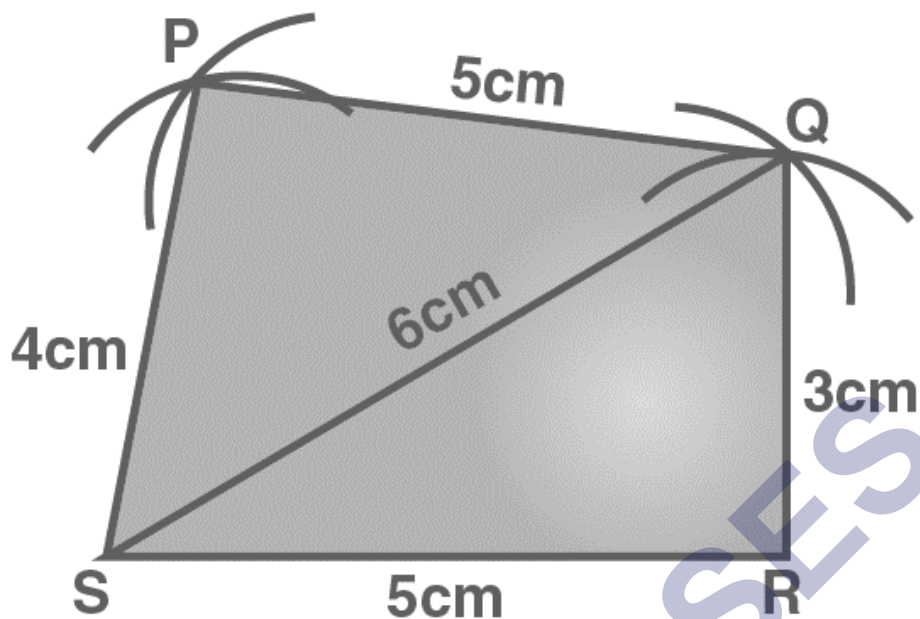
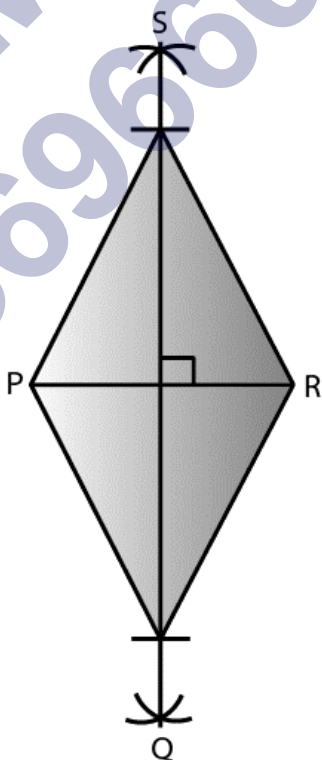- You obtain the quadrilateral PQRS of the required measurements.

Special Quadrilaterals

Construction of a Quadrilateral When Other Special Properties Are Known

Construct a rhombus PQRS with diagonals PR = 5.2 cm and QS = 6.4 cm

[Make a rough figure for your reference]

Note: Diagonals of a rhombus are perpendicular bisectors of each other.

Steps of construction of the Rhombus:

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Step 1: Draw a line segment PR of length 5.2 cm.

Step 2: Draw the perpendicular bisector of PR. Name the point O, where the perpendicular bisector of PR and PR intersect.

Step 3: With O as center and radius equal to 3.2 cm cut arcs on both sides of the perpendicular bisector. Name them as Q and S.

Step 4: Join, PQ, QR, RS, and PS.

Introduction to Practical Geometry

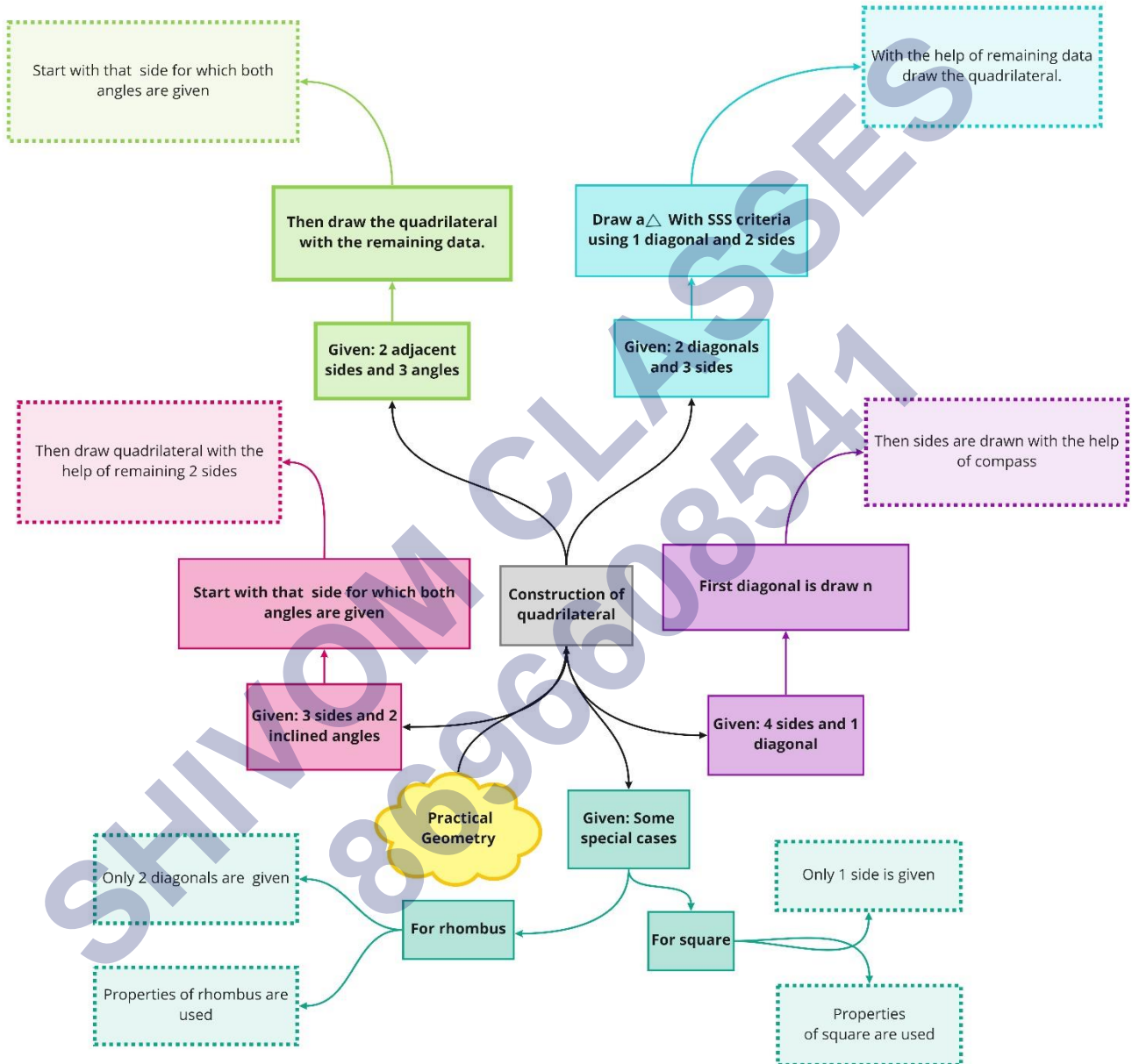**Number of measurements necessary for construction of a unique Quadrilateral**

To draw a unique quadrilateral, we need at least five measurements of sides and angles. However, it is not necessary that we will get a unique quadrilateral if we have the measurements of any five combinations of sides and angles.

For example, a unique quadrilateral can be drawn if we are given the measurement of four sides and one diagonal of a quadrilateral.

However, a unique quadrilateral will not be drawn if we are given the measurement of two diagonals and three angles of a quadrilateral.\

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Start with that side for which both angles are given

With the help of remaining data draw the quadrilateral.

Then draw the quadrilateral with the remaining data.

Draw a △ With SSS criteria using 1 diagonal and 2 sides

Given: 2 adjacent sides and 3 angles

Given: 2 diagonals and 3 sides

Then draw quadrilateral with the help of remaining 2 sides

Then sides are drawn with the help of compass

Start with that side for which both angles are given

Construction of quadrilateral

First diagonal is draw n

Given: 3 sides and 2 inclined angles

Given: 4 sides and 1 diagonal

Practical Geometry

Given: Some special cases

Only 2 diagonals are given

Only 1 side is given

For rhombus

For square

Properties of rhombus are used

Properties of square are used

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Important Questions

Multiple Choice Questions:

Question 1. Sum of all interior angles of a polygon with (n) sides is given by

(a) $(n - 2) \times 180°$

(b) $n - 2 \times 180°$

(c) $(n + 2) \times 180°$

(d) $(n + 2) \times 180°$

Question 2. Polygons that have no portions of their diagonals in their exteriors are called

(a) triangles

(b) convex

(c) concave

(d) squares

Question 3. What is the number of sides in Hexagon ?

(a) 4

(b) 7

(c) 6

(d) 5

Question 4. A parallelogram must be a rectangle if its diagonals

(a) bisect the angles to which they are drawn

(b) are perpendicular to each other

(c) bisect each other

(d) are congruent

Question 5. Diagonals of a rectangle:

(a) equal to each other

(b) not equal

(c) one is double of the other

(d) none of these

Question 6. A simple closed curve made up of only _____ is called a polygon.

(a) lines

(b) curves

(11)

(c) closed curves

(d) line segments

Question 7. To construct a quadrilateral uniquely, it is necessary to know at least_____ of its parts.

(a) 5

(b) 4

(c) 3

(d) 2

Question 8. All the angles of a regular polygon are of _____.

(a) 90°

(b) 60°

(c) equal length

(d) equal measure

Question 9. The diagonals of a square bisect each other at _____ angle.

(a) acute

(b) right

(c) obtuse

(d) reflex

Question 10. The quadrilateral whose diagonals are equal and bisect each other at right angle is _____.

(a) Triangle

(b) Square

(c) Rhombus

(d) None of these

Very Short Questions:

Short Questions:

Long Questions:

1. Construct a quadrilateral PQRS, given that QR = 4.5 cm, PS = 5.5 cm, RS = 5 cm and the diagonal PR = 5.5 cm and diagonal SQ = 7 cm.

2. Construct a quadrilateral ABCD in which AB = 4 cm, BC = 3.5 cm, CD = 5 cm, AD = 5.5 cm and ∠B = 75°.

3. Construct a square whose side is 5 cm.

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4. Construct a rhombus ABCD in which AB = 5.8 cm and AC = 7.5 cm.

5. Construct a rhombus whose diagonals are 6 cm and 8 cm.

6. Construct a rectangle whose diagonal is 5 cm and the angle between the diagonal is 50°.

7. Construct a quadrilateral ABCD in which BC = 4 cm, ∠B = 60°, ∠C = 135°, AB = 5 cm and ∠A = 90°.

8. Construct a parallelogram ABCD in which AB = 5.5 cm, AC = 7 cm and BD = 8 cm.

9. Construct a rhombus PAIR, given that PA = 6 cm and angle ∠A = 110°.

Answer Key-

Multiple Choice Questions:

1. (a) (n – 2) × 180°

2. (b) convex

3. (c) 6

4. (d) are congruent

5. (a) equal to each other

6. (d) line segments

7. (a) 5

8. (d) equal measure

9. (b) right

10. (b) Square

Very Short Answer :

Short Answer :

Long Answer :

1.

(Rough sketch)   (Fair figure)

(13)
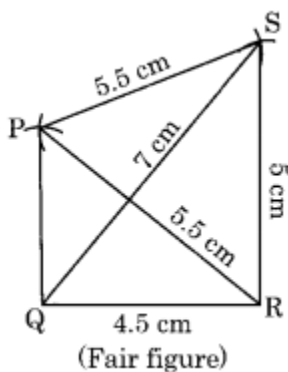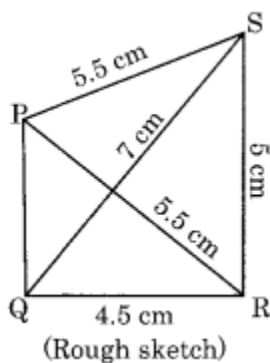
Construction:

Step I: Draw QR = 4.5 cm.

Step II: Draw an arc with centre R and radius 5 cm.

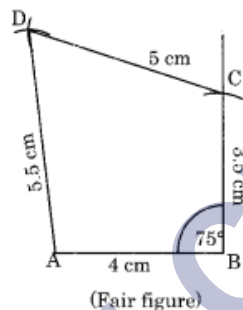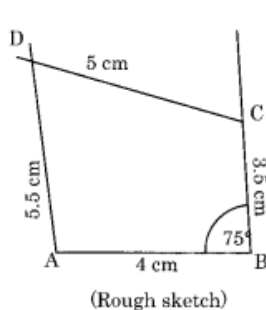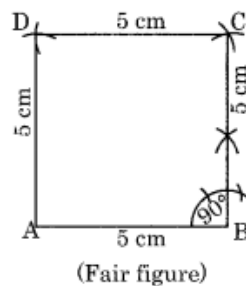Step III: Draw another arc with centre Q and radius 7 cm to meet the previous arc at S.

Step IV: Join RS and QS.

Step V: Draw two arcs with centre S and R and radius 5.5 cm each to meet each other at P.

Step VI: Join RP, SP and PQ.

Thus PQRS is the required quadrilateral.

2.

(Rough sketch)   (Fair figure)

Construction:

Step I: Draw AB = 4 cm.

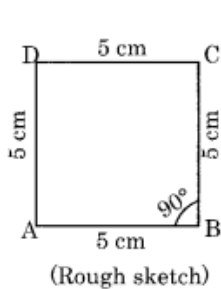Step II: Draw an angle of 75° at B and cut BC = 3.5 cm.

Step III: Draw an arc with centre C and radius 5 cm.

Step IV: Draw another arc with centre A and radius 5.5 cm to meet the previous arc at D.

Step V: Join CD and AD.

Thus ABCD is the required quadrilateral.

3.

(Rough sketch)   (Fair figure)

Construction:

(14)

Step I: Draw AB = 5 cm.
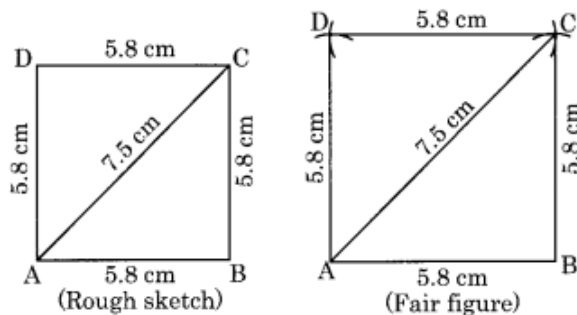
Step II: Draw an angle of 90° at B and cut BC = 5 cm.

Step III: Draw two arcs with centre A and C and same radii of 5 cm which meet each other at D.

Step IV: Join AD and CD.

Thus, ABCD is the required square.

4.

(Rough sketch)   (Fair figure)

Construction:

Step I: Draw AB = 5.8 cm.
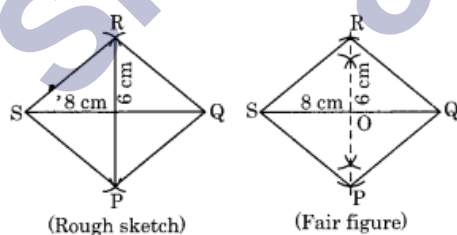
Step II: Draw an arc with centre B and radius 5.8 cm.

Step III: Draw another arc with centre A and radius 7.5 cm to meet the previous arc at C.

Step IV: Draw two arcs with centres A and C and of the same radius 5.8 cm to meet each other at D.

Step V: Join BC, AC, CD and AD.

Thus ABCD is the required rhombus.

5.

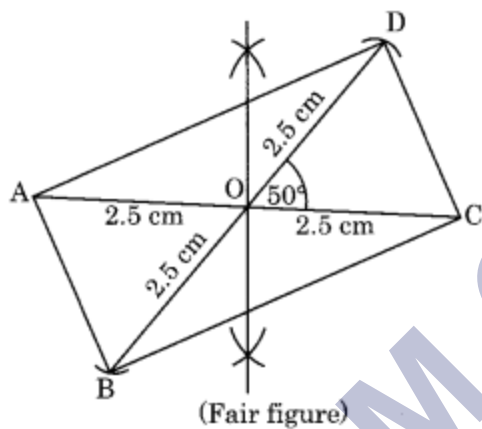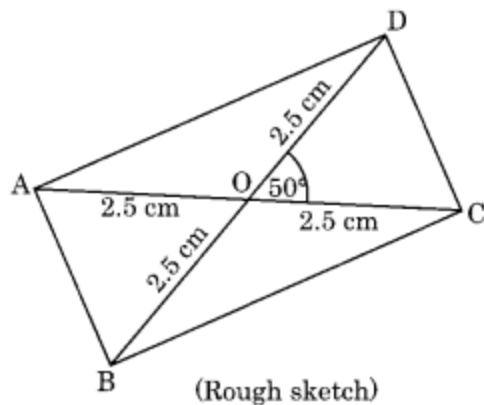(Rough sketch)   (Fair figure)

Construction:

Step I: Draw SQ = 8 cm.

Step II: Draw a right bisector of SQ at O.

Step III: Draw two arcs with centre O and radius 3 cm each to cut the right bisector at P and R.

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Step TV: Join PQ, QR, RS and SP.

Thus PQRS is the required rhombus.

6.

(Rough sketch)

(Fair figure)

Construction:

Step I: Draw AC = 5 cm.
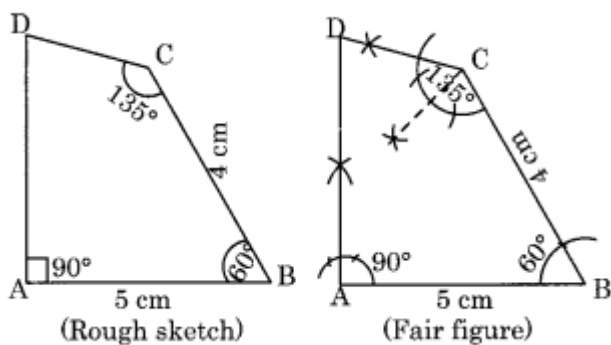
Step II: Draw the right bisector of AC at O.

Step III: Draw an angle of 50° at O and product both sides.

Step IV: Draw two arcs with centre O and of the same radius 2.5 cm to cut at B and D.

Step V: Join AB, BC, CD and DA.

Thus, ABCD is the required rectangle.

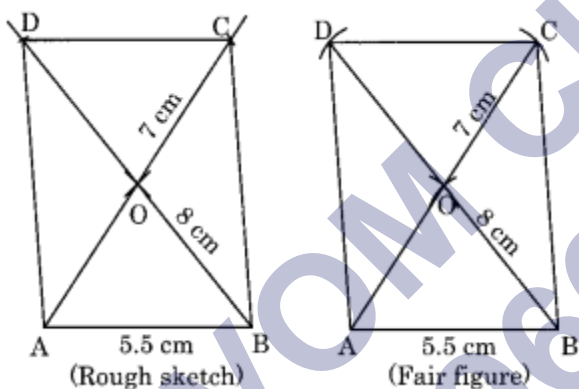**7.**

(16)

(Rough sketch) (Fair figure)

Construction:

Step I: Draw AB = 5 cm.

Step II: Draw the angle of 60° at B and cut BC = 4 cm.

Step III: Draw an angle of 135° at C and angle of 90° at A which meet each other at D.

Thus, ABCD is the required quadrilateral.

8.

(Rough sketch) (Fair figure)

Construction:

Step I: Draw AB = 5.5 cm.

Step II: Draw an arc with centre B and radius $\frac{8}{2}$ cm = 4 cm.

Step III: Draw another arc with centre A and radius $\frac{7}{2}$ cm = 3.5 cm which cuts the previous arc at O.

Step IV: Join AO and produce to C such that AO = OC.

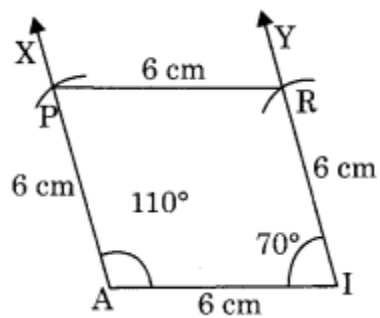Step V: Join BO and produce to D such that BO = OD.

Step VI: Join BC, CD and AD.

Thus ABCD is the required parallelogram.

9.

Since in a rhombus, all sides are equal, so PA = AI = IR = RP = 6 cm

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Also, rhombus is a parallelogram

so, adjacent angle, ∠I = 180° − 110° = 70°

Steps of construction

Step I. Draw AI = 6 cm

Step II. Draw ray $\overline{AX}$ such that ∠IAX = 110° and draw $\overline{IY}$ such that ∠AIY = 70°.

Step III. With A and I as centres and radius 6 cm draw arcs intersecting AX and IY at P and R respectively.

Step IV. Join PR.

Thus, PAIR is the required rhombus.